Experimental Technique for Radiative-Process-Resolved X-Ray Absorption Spectroscopy at the Inner-Shell Excitation Thresholds

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Partial-fluorescence-yield (PFY) x-ray absorption measurements, using the optimized window widths of position sensitive detectors in wave-length dispersive x-ray spectrometers, have been applied for radiative-process-resolved (RPR) x-ray absorption spectroscopy [1]. For such the PFY absorption measurements, we can selectively extract x-ray emission signals from specified radiation processes by optimizing the window width on the PSD of a grating x-ray spectrometer installed in BL-8.0.1. Figure 1 shows the top view of the optical arrangement for the measurements. In this arrangement, the high-energy and low-energy window widths on the PSD can be varied by adjustments of the high- and low-energy masks. To measure the PFY absorption spectra, we scanned the incident beam energy monitoring the x-ray intensities detected on the PSD whose window widths were optimized by its high- and low-energy masks. We measured PFY-absorption spectra of graphite and diamond at the C *K* threshold and of *h*-BN and *c*-BN at the B *K* threshold. From these measurements, resonant elastic x-ray scattering was observed in graphite and *h*-BN on their PFY absorption spectra, and excitonic x-ray scattering was observed in diamond and *c*-BN [1]. We also measured the PFY-absorption spectrum of NiO at the Ni *L* threshold, resolving the Lα and Lβ x-ray emission processes, as shown in Figure 2. These results show that PFY absorption measurements for RPR x-ray absorption spectroscopy can provide the information about the electronic structures and the radiative-decay process in inner-shell excitation.

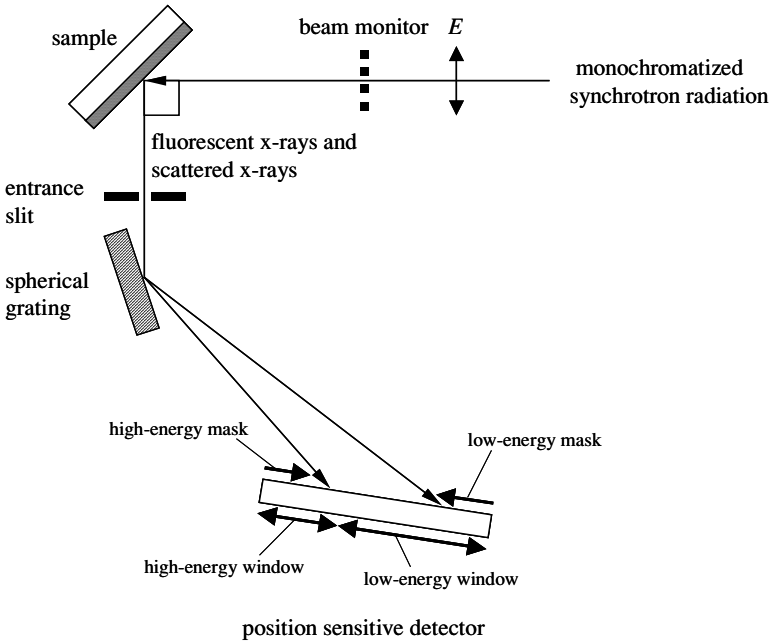

Figure 1. Top view of the optical arrangement for the PFY absorption measurements in BL-8.0.1.

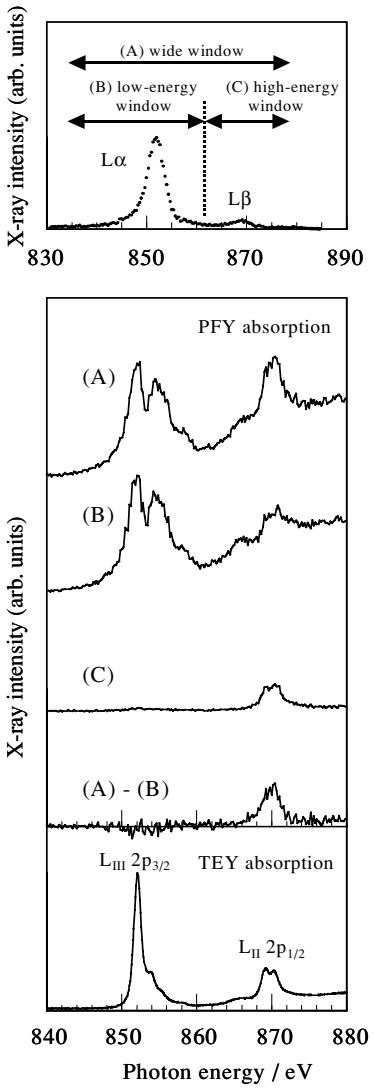

Figure 2. Ni *L* x-ray emission spectrum (upper panel) and PFY and total-electron-yield (TEY) x-ray absorption spectra (lower panel) of NiO. The PFY x-ray absorption spectra were taken by monitoring the x-ray intensity measured by the PSD with (A) wide, (B) low-energy, and (C) high-energy windows. Spectrum obtained after subtracting (B) from (A), denoted by (A) - (B) is also shown.

[1] Y. Muramatsu et al., J. Synchrotron Radiation (in press).

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